

REMARKS

Claims 10-19 are pending and under consideration in the application. Claims 10-12 and 14-16 have been amended herewith. Support for these amendments may be found at least on pages 11-13 and 16-22. The specification has been amended to correct grammatical errors introduced during translation. Applicants respectfully submit that no new matter has been introduced by way of this amendment.

The Examiner has objected to the IDS filed March 30, 2000 as failing to comply with 37 CFR §1.98(a)(3). Claim 12 is objected to. Claims 14-16 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Claims 10-17 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Humphrey, Jr. et al., U.S. 5,922,493. Claims 18 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Humphrey, Jr. et al., U.S. 5,922,493.

In response to the Examiner's objection to the IDS as failing to comply with 37 CFR §1.98(a)(3), we submit with this amendment the English abstracts of the non-English references to provide a concise explanation of the relevance as presently understood.

Claim 12 is objected to because a typographical error appears in line 1 in that "Claim 110" should be "Claim 10." Claim 12 has been amended to correct this error. Applicants respectfully request withdrawal of the objection of Claim 12.

The rejection of Claims 14-16 under 35 U.S.C. § 112, second paragraph, is respectfully traversed. Applicants submit that the rejection has been rendered moot in light of the instant amendment. Claim 14 has been amended to recite, among other things, "the positive and negative electrodes comprises a binder comprising the matrix polymer of the solid electrolyte" to more clearly define the invention. Claims 15 and 16 have been amend to recite, among other things, "a material which is capable of intercalating or deintercalating a lithium ion" as suggested by the Examiner to correct a grammatical error. Applicants respectfully request withdrawal of the §112, second paragraph, rejection of Claims 14-15.

The rejection of Claims 10-17 under 35 U.S.C. § 102(e) as being anticipated by Humphrey, Jr. et al., U.S. 5,922,493 is respectively traversed.

Humphrey, Jr. et al. disclose an electrochemical cell having a positive electrode, an absorber-separator and a negative electrode wherein at least one of the electrodes or absorber-

separator comprises a porous polyvinylidene fluoride (PVDF). The porous PVDF electrodes have an electrode material and the porous PVDF absorber-separator has an electrolyte material. The PVDF molecular weight values disclosed in Humphrey, Jr. et al. range from 86,900 to 572,500. Humphrey, Jr. et al. does not teach or suggest a solid electrolyte having a matrix polymer having a fluorocarbon polymer with a weight -average molecular weight greater than 572,500.

Claim 10 has been amended to recite "a solid electrolyte comprising a matrix polymer comprising a fluorocarbon polymer having a weight -average molecular weight greater than 572,500." Applicants may amend a claim to exclude subject matter disclosed in the prior art. *In re Johnson and Farnham*, 194 U.S.P.Q. 187, 195-96 (CCPA 1977). Further, Applicants have unexpectedly discovered that a fluorocarbon polymer having a weight-average molecular weight of *at least* 550,000 provides excellent adhesion to the active material layers of the positive and negative layers. Humphrey, Jr. et al. discloses only one example falling within this range; Applicants disclose six embodiments wherein the weight-average molecular weight ranges from 600,000 to 2,000,000, each of which fall within the range newly recited in Claim 10. Applicants respectfully submit that Claim 10 is patentable over Humphrey, Jr. et al.

Claims 11-17 depend from independent Claim 10. Applicants submit that when the recitations of Claims 11-17 are considered in combination with Claim 10, Claims 11-17 are likewise patentable over Humphrey, Jr. et al.

Applicants respectfully request withdrawal of the § 102(e) rejection of Claims 10-17 as being anticipated by Humphrey, Jr. et al., U.S. 5,922,493.

The rejection of Claims 18 and 19 under 35 U.S.C. § 103(a) as being unpatentable over Humphrey, Jr. et al., U.S. 5,922,493 is respectively traversed.

Humphrey, Jr. et al. has been described and distinguished above, the arguments of which are incorporated herein by reference.

Claims 18 and 19 depend from independent Claim 10. Applicants submit that when the recitations of Claims 18 and 19 are considered in combination with Claim 10, Claims 18 and 19 are likewise patentable over Humphrey, Jr. et al.

Applicants respectfully request withdrawal of the § 103(a) rejection of Claims 18 and 19 as being unpatentable over Humphrey, Jr. et al., U.S. 5,922,493.

CONCLUSION

In view of the foregoing, it is submitted that Claims 10-19 are patentable. It is therefore submitted that the application is in condition for allowance. Notice to that effect is respectfully requested.

Respectfully submitted,



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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification

In the paragraph beginning at page 1, line 11:

--In recent years, many portable electronic apparatuses such as an integral VTR/video camera unit, portable telephone, portable computer, etc. have been proposed, and they show a tendency to be more compact for their improved portability. Many developments and [researches] studies have been made to provide a thinner or bendable battery, more specifically, a secondary battery, or a lithium ion battery among others, for use as a portable power source in such a more compact portable electronic apparatus.--

In the paragraph beginning at page 1, line 18:

--To attain such a thinner or bendable battery structure, active [researches] studies have been made concerning a solidified electrolyte for use in the battery. Especially, a gel electrolyte containing a plasticizer and a polymeric solid electrolyte made from a high molecular material having lithium salt dissolved therein are attracting much attention from many fields of industry.--

In the paragraph beginning at page 5, line 10:

-- [To attain the above object, the Inventors have been made many researches for a long term. As a result of the researches,] It has been found that the molecular weight of a fluorocarbon polymer used as a matrix polymer in the solid electrolyte has a great influence on the characteristics of the electrolyte, use of a fluorocarbon polymer having a large molecular weight makes it possible to adhere a high molecular solid or gel electrolyte to the active material of the electrodes with a sufficient strength and provide [a] good electrical contact between the solid or gel electrolyte and the active material of the positive and negative electrodes, and that use of such a fluorocarbon polymer [allows to provide] provides a solid-electrolyte secondary battery having a longer charge and discharge [cycle life] life cycle and [an] excellent productivity.--

In the paragraph beginning at page 6, line 8:

--According to the present invention, a fluorocarbon polymer of 550,000 or more in weight-average molecular weight (Mw) is used as the matrix polymer. The fluorocarbon polymer of 550,000 or more in weight-average molecular weight assures an excellent adhesion of the electrolyte to the active material of the positive and negative electrodes. Therefore, it is possible to adhere the high molecular solid or gel electrolyte to the active material of the electrodes with a sufficient strength and thus reduce the internal resistance of the electrodes, thereby [permitting to attain] attaining an improved charge and discharge [cycle life] life cycle of the battery.--

In the paragraph beginning at page 8, line 17:

--In case a fluorocarbon polymer of 550,000 or more in weight-average molecular weight (Mw) is used, another fluorocarbon of over 300,000 and under 550,000 in Mw may be used in combination to lower the viscosity for facilitating to form a film of the electrolyte. In this case, however, the ratio of the fluorocarbon polymer of 550,000 or more in Mw should preferably be 30% or more by weight. If the [ration] ratio of the fluorocarbon polymer of 550,000 or more in Mw is lower, it will be difficult to ensure an intended sufficient adhesive strength of the solid electrolyte.--

In the paragraph beginning at page 9, line 17:

--The hexafluoropropylene or ethylene tetrafluoride may be totally added into a polymerization container during the initial charging. Otherwise, it may partially or wholly be [add] added in a divisional or continuous manner to the polymerization container after the initial charging.--

In the paragraph beginning at page 9, line 21:

--A chain transfer agent used at this time includes acetone, isopropyl acetate, ethylacetate, diethyl carbonate, dimethyl carbonate, baked ethyl carbonate, propionic acid, trifluoroacetic acid, trifluoroethyl alcohol, formaldehyde dimethyl acetal, 1, 3-butadiene epoxide, 1, 4-dioxane, β -butyl lactone, ethylene carbonate, vinylene carbonate or the like. Among them, however, acetone or ethylene acetate should preferably be used for [the] easy availability and handling.--

In the paragraph beginning at page 12, line 1:

--The solid or gel electrolyte contains a lithium salt which may be [a one] used in ordinary battery electrolytes. More particularly, the lithium salt may be [a one] selected from lithium chloride, lithium bromide, lithium iodide, lithium chlorate, lithium perchlorate, lithium bromate, lithium iodate, lithium nitrate, tetrafluoro lithium borate, hexafluoro lithium phosphate, lithium acetate,, bis(trifluoromethane sulfonyl)imide lithium, LiAsF_6 , LiCF_3SO_3 , $\text{LiC}(\text{SO}_2\text{CF}_3)_3$, LiAlCl_4 , LiSiF_6 , etc.--

In the paragraph beginning at page 12, line 7:

--These lithium salts may be used singly or in combination as mixed together, but among them, LiPF_6 and LiBF_4 should desirably be used for [the] oxidation stability.--

In the paragraph beginning at page 13, line 6:

--The positive electrode may be formed from a metal oxide, metal sulfide or a special high molecular compound used as a positive electrode active material depending upon an intended type of battery. For a lithium ion battery, for example, the positive electrode active material may be a metal sulfide or oxide containing no lithium such as TiS_2 , MoS_2 , NbSe_2 , V_2O_5 or the like, or a lithium composite oxide or the like containing as the base LiMO_2 (M is one or more kind of transition metal, and x differs depending upon the charged or discharged extent of the battery, normally over 0.05 and under 1.10). The transition metal M composing the lithium composite oxide should preferably be Co, Ni, Mn or the like. More particularly, the lithium composite oxides include LiCoO_2 , LiNiO_2 , $\text{LiNi}_{1-y}\text{CO}_{y}\text{O}_2$ ($0 < y < 1$), LiMn_2O_4 . These lithium composite oxides can be a positive electrode active material [allowing to generate] generating a high voltage and providing excellent [in] energy density. The positive electrode may be formed from more than one of these active materials. For forming a positive electrode from any of these active materials, a well-known conducting material, binder or the like may be added to the active material.--

In the paragraph beginning at page 14, line 7:

--The following monomers and auxiliaries were charged into a pressure-resistant autoclave made of a stainless steel and having a volume of 14 liters, and the polymerization was started at a temperature of 25°C:--

In the paragraph beginning at page 15, line 12:

--A Ubbelohde viscometer was used to measure an efflux time at 30°C of a solution in which the powder of the polymer was dissolved in dimethyl formamide at a concentration of 4 g/liter. The following equation was used to calculate a logarithmic viscosity number from the measured efflux time:--

In the paragraph beginning at page 16, line 11:

--To produce a positive electrode active material (LiCoO₂), lithium carbonate and cobalt carbonate were mixed at a ratio of 0.5 mol to 1 mol and sintered in the atmosphere at 900°C for 5 hours. Ninety one parts by weight of the LiCoO₂ [thus] produced, 6 parts by weight of graphite as a conducting material and 10 parts by weight of vinylidene fluoride/hexafluoropropylene copolymer were mixed together to prepare a positive electrode mixture. The mixture was further dispersed in N-methyl-2-pyrolidone to produce a slurry. The slurry was applied uniformly to one side of an aluminum foil stripe of 20 µm in thickness used as [an] a cathode collector. After the slurry was dried, the aluminum foil stripe was compressed and formed by the roll press to produce a positive electrode.--

In the paragraph beginning at page 22, line 1:

--The experimental embodiment 6 [uses] having a fluorocarbon polymer of 2,000,000 in weight-average molecular weight (Mw) is excellent in peel strength and output maintenance factor as shown, but it showed a productivity not so good because of its high viscosity.--

In the paragraph beginning at page 22, line 5:

--As having been described in the foregoing, the present invention can provide a solid electrolyte excellent in adhesion to the electrode active material layers, and thus the present invention can also provide a solid-electrolyte secondary battery with a solid electrolyte having a

good electrical contact with positive and negative active material layers and having a considerably improved charge and discharge [cycle] life cycle.--

In the paragraph beginning at page 25, line 2:

--A solid-electrolyte secondary battery is provided which comprises a positive electrode, negative electrode and a solid electrolyte provided between the electrodes. The solid electrolyte contains as a matrix polymer a fluorocarbon polymer of 550,000 in weight-average molecular weight (Mw). The fluorocarbon polymer having a weight-average molecular weight of more than 550,000 shows an excellent adhesion to the active material layers of the positive and negative layers. Therefore, the high polymer solid (or gel) electrolyte adheres to the active material layers of the electrodes with a sufficient adhesive strength. [From the standpoint of the coating viscosity] A fluorocarbon polymer having a weight-average molecular weight (Mw) over 300,000 and under 550,000 may be used in combination with a fluorocarbon polymer of 550,000 or more in weight-average molecular weight to lower the viscosity for facilitating the formation of a film of the electrolyte.--

In the Claims

10. A solid-electrolyte secondary battery comprising:
 - a positive electrode;
 - a negative electrode;
 - a solid electrolyte comprising a matrix polymer comprising a fluorocarbon polymer having a weight-average molecular weight of [at least 550,000] greater than 572,500.
11. The solid-electrolyte secondary battery of Claim [110] 10 wherein the matrix polymer further comprises a second fluorocarbon polymer having a weight-average molecular weight of greater than 300,000 and less than 550,000[, and a fluorocarbon polymer having a weight-average molecular weight of at least 550,000].
12. The solid-electrolyte secondary battery of Claim 10 wherein the matrix polymer comprises 30 percent or more by weight of the fluorocarbon polymer that has a weight-average molecular weight of [at least 550,000] greater than 572,500.

14. The solid-electrolyte secondary battery of Claim 10 wherein at least one of the positive and negative electrodes comprises a binder comprising [a polymer material having a molecular structure that is the same or similar to] the matrix polymer of the solid electrolyte.
15. The solid-electrolyte secondary battery of Claim 10 wherein the negative electrode comprises a material [into or from which a lithium ion can be inserted or extracted] which is capable of intercalating or deintercalating a lithium ion.
16. The solid-electrolyte secondary battery of Claim 15 wherein the material [into or from which a lithium ion can be inserted or extracted] which is capable of intercalating or deintercalating a lithium ion [is] comprises a carbon material.